

FIG. 3A

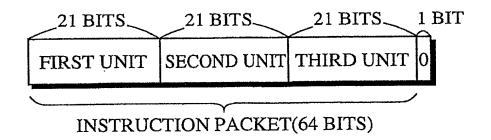


FIG. 3B PARALLEL EXECUTION BOUNDARY 0 FIRST UNIT 2 UNIT 3 UNIT 1 **CYCLE SECOND** UNIT 5 UNIT 6 UNIT 4 **CYCLE** THIRD UNIT 7 UNIT 8 UNIT 9 **CYCLE** 

FIG. 3C

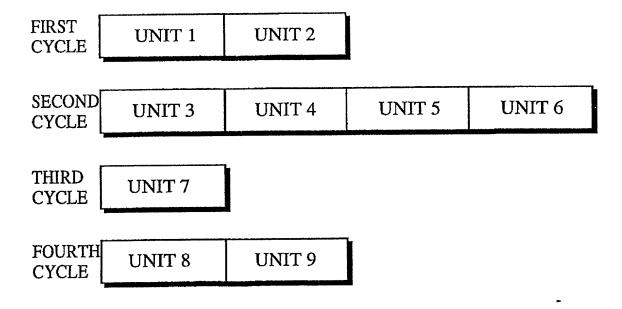


FIG. 4

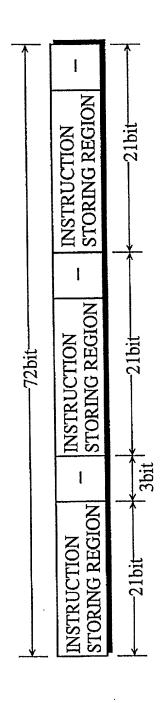


FIG. 5

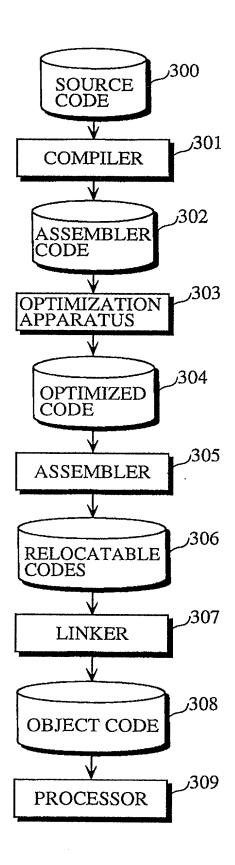


FIG. 6

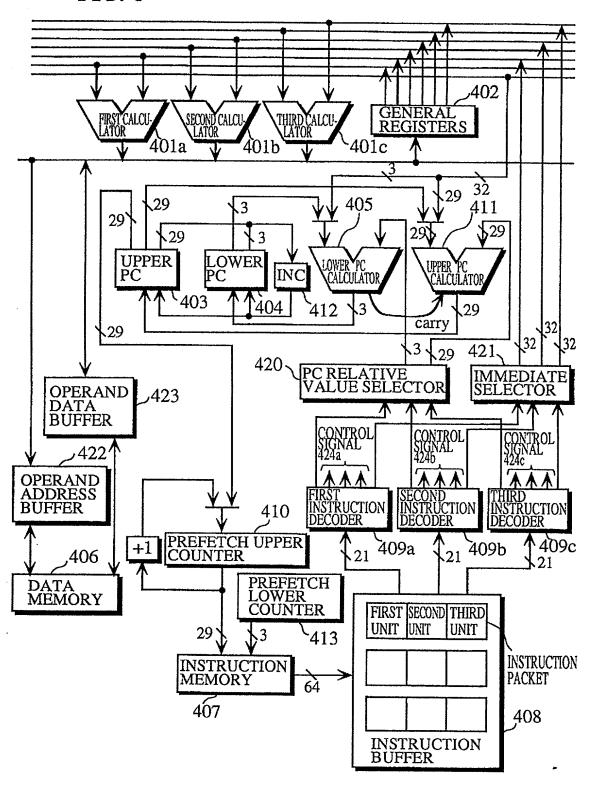


FIG. 7

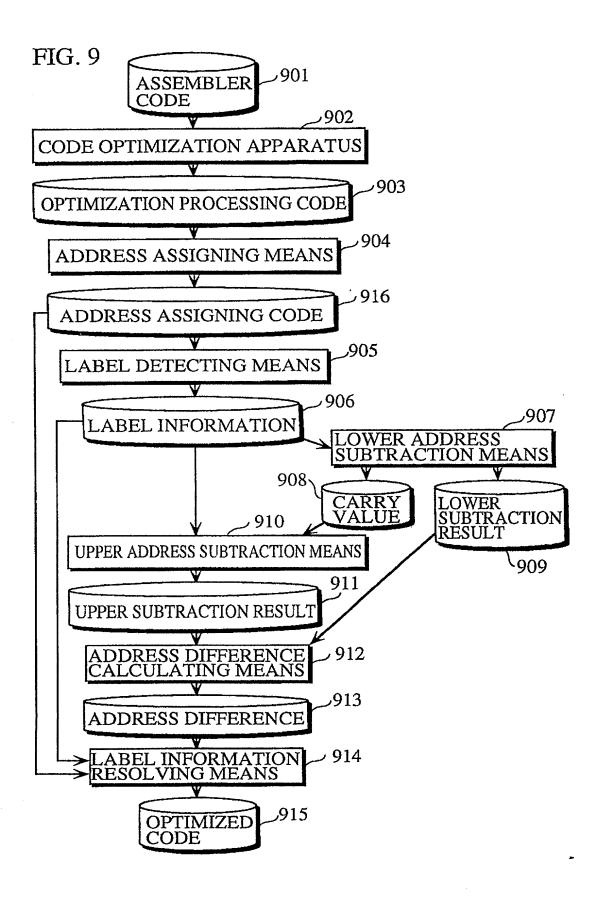
| IN-PACKET ADDRESS BEFORE UPDATING INCREMENT VALUE | 3'5000              | 3,2010              | 3'5100              |
|---|---------------------|---------------------|---------------------|
| 1   | 3.5010              | 3'b100              | 3'b000<br>(CARRY 1) |
| 2   | 3'b100              | 3'b000<br>(CARRY 1) | 3'b010<br>(CARRY 1) |
| 3   | 3'b000<br>(CARRY 1) | 3'b010<br>(CARRY 1) | 3'b100<br>(CARRY 1) |
| 4   | 3'b010<br>(CARRY 1) | 3'b100<br>(CARRY 1) | 3'b000<br>(CARRY 2) |

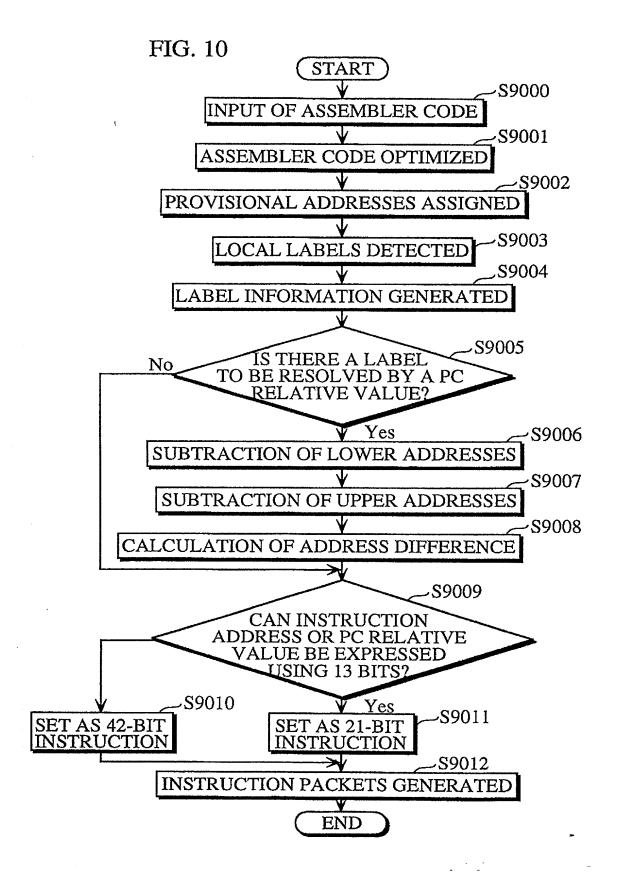
FIG. 8A

| LOWER 3 BITS<br>OF ADDRESS<br>LOWER 3 VALUE<br>BITS OF PC<br>RELATIVE VALUE | 3'b000 | 3'b010              | 3'b100              |
|---|--------|---------------------|---------------------|
|   |        |                     |                     |
| 3'b000  | 3'b000 | 3'b010              | 3'b100              |
| 3'b010  | 3'b010 | 3'b100              | 3'b000<br>(CARRY 1) |
| 3'b100  | 3'b100 | 3'b000<br>(CARRY 1) | 3'b010<br>(CARRY 1) |

FIG. 8B

| OF VA                   | WER 3 BITS<br>ADDRESS<br>LUE(TO BE<br>BTRACTED)  |        |           |           |
|-------------------------|--|--------|-----------|-----------|
| I OXYED A D             | TOTAL STATE OF THE |        |           |           |
| LOWER 3 BI<br>OF ADDRES |  |        |           |           |
| VALUE(BEF<br>SUBTRACT)  | ORE (ON)   | 3'b00  | 0b010     | 0b100     |
|                         |  |        |           |           |
|                         | 3'b000   | 3'b000 | 3'b100    | 3'b010    |
|                         |  |        | (CARRY 1) | (CARRY 1) |
|                         | 3'b010   | 3'b010 | 3'b000    | 3'b100    |
|                         | all 100  |        |           | (CARRY 1) |
|                         | 3'b100   | 3'b100 | 3'b010    | 3'b000    |
|                         |  |        |           | -         |





|       |             | <b>L</b> |   |      |
|-------|-------------|----------|---|------|
| L1:   | mov r2, r1  |          | • | 1000 |
|       | jsr f       | •        | • | 1001 |
|       | add r0, r4  | •        | • | 1002 |
|       | and r1, r3  | •        | • | 1003 |
|       | mov L2, r2  | ٠        | • | 1004 |
|       | ld (r2), r0 | •        | • | 1005 |
|       | bra L1      |          | • | 1006 |
|       | add r2, r3  |          | • | 1007 |
| • • • |             |          |   |      |
| L2:   | •••         | •        | • | 1008 |
|       |             |          |   |      |

FIG. 12

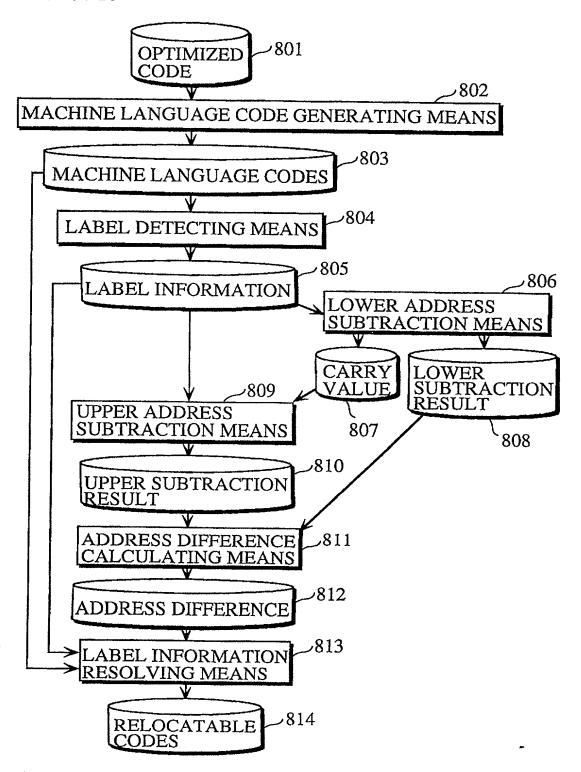
|              |                | _        |
|--------------|----------------|----------|
| 32'h00000800 | L1: mov r2, r1 | · · 1000 |
| 32'h00000802 | jsr f          | • • 1001 |
| 32'h00000804 | add r0, r4     | • • 1002 |
| 32'h00000808 | and r1, r3     | • • 1003 |
| 32'h0000080a | mov L2, r2     | • • 1004 |
| 32'h00000810 | ld (r2), r0    | • • 1005 |
| 32'h00000812 | bra L1         | • • 1006 |
| 32'h00000814 | add r2, r3     | • • 1007 |
|              | •••            |          |
| 32'h12345678 | L2:            | • • 1008 |
|              |                | -000     |

| INSTRUCTION | RESOLVING VALUE   | 3                         |
|-------------|-------------------|---------------------------|
| mov L2, r2  | ADDRESS           | 32'h12345678              |
| bra L1      | PC RELATIVE VALUE | 32'h00000800-32'h00000812 |

```
L1: mov r2, r1 || jsr f || add r0, r4 | · · 1300 |
    and r1, r3 || mov L2, r2 || (mov L2, r2) | · · 1301 |
    ld (r2), r0 || bra L1 || add r2, r3 | · · 1302 |
    ...

L2: · · 1303
```

FIG. 15



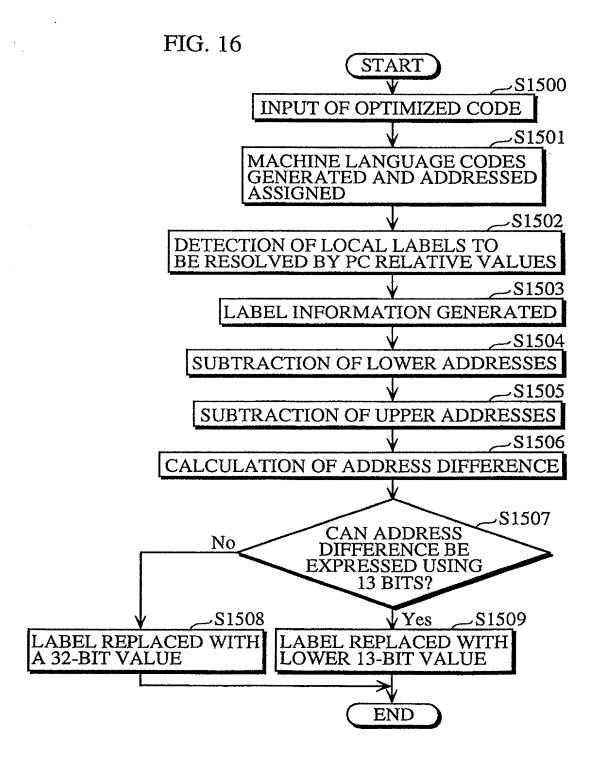
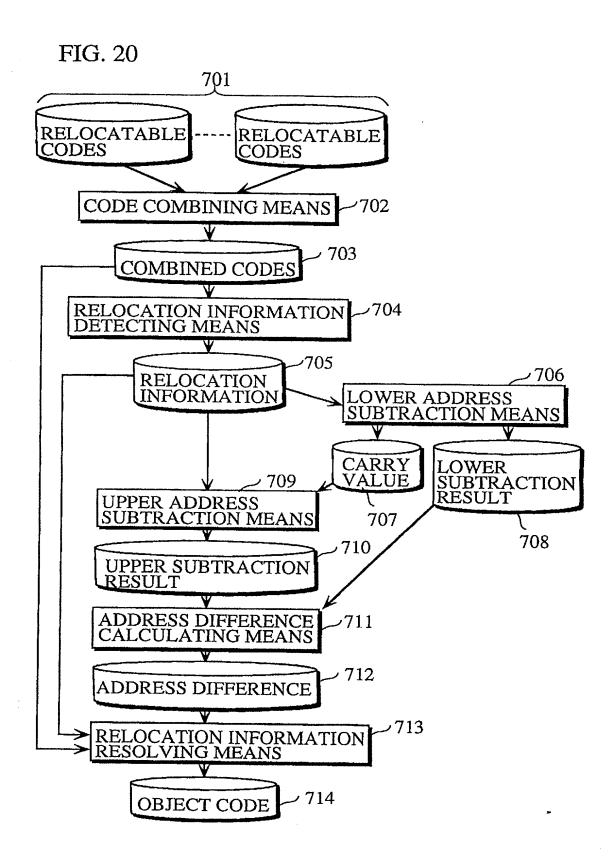


FIG 17

| 1411     |                    |                    |       | :                            | L2: | 29'h02468acf      |
|----------|--------------------|--------------------|-------|------------------------------|-----|-------------------|
|          |                    |                    |       |                              | :   |                   |
| 1407     | add r2, r3 ···1410 | L11409             | bra I | ld (r2), r0 ···1408   bra L1 |     | 29'h00000002      |
| • • 1404 |                    | mov L2, r2 ···1406 |       | and r1, r3 ···1405           |     | 29'h000000001     |
| 1400     | add r0, r4 ···1403 | 1402               | jsr f | mov r2, r1 ··· 1401 jsr f    | L1: | 29'h000000000 L1: |
|          |                    |                    |       |                              |     |                   |

| INSTRUCTION | RESOLVING VALUE   |                           |
|-------------|-------------------|---------------------------|
| bra L1      | PC RELATIVE VALUE | 32'h00000000-32'h00000012 |

FIG. 10



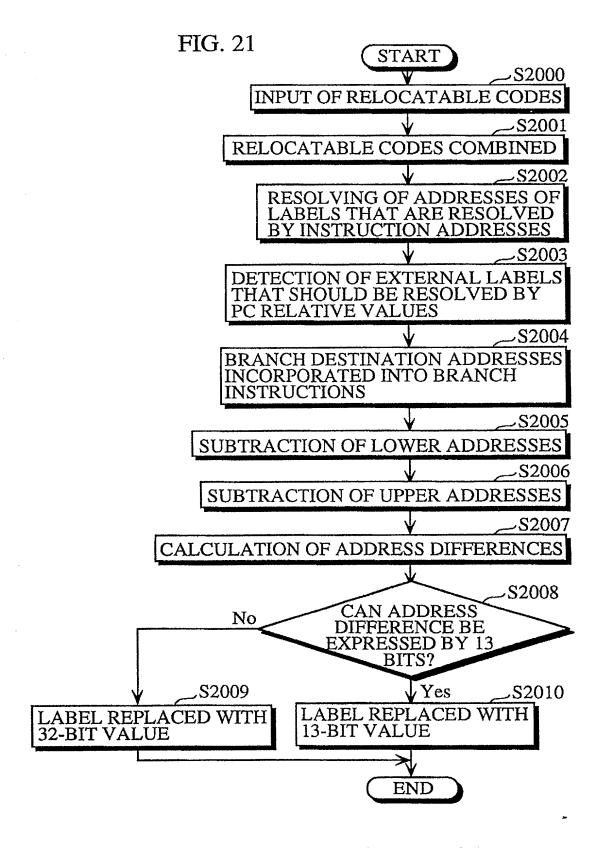


FIG. 27

|                      | •         |
|----------------------|-----------|
|                      | 1703 0    |
|                      | nop       |
|                      | 1/071:0   |
|                      | don       |
| .0.1010101           | יטיט דט ד |
| ret                  |           |
| 29'h000000000 0;0;f: |           |

FIG. 23

| 29'h000000000   0;0;f: | 0.0 f:  | ret ·   | 1801 0 0 nop |              | ···1802 [1:0] nop | 0   | dou                        | 1803 0 | · | • | 1800       |
|------------------------|---------|---|--------------|--------------|-------------------|-----|----------------------------|--------|---|---|------------|
| 29'h000000001 0'0 L1:  | 0.0 L1: | mov r2, r1 ···1805 1; 0 jsr f   | 1805 1:0     |              | 1806              | 0.0 | 1806 0:0; add r0, r41807 0 | 1807   |   | • | 1804       |
| 29'h000000002  0;0     | 0:0     | and r1, r3 ···1809 1;1;mov L2, r2 ···1810                             | 1809 1:1     | mov L2, r2   | 181               | 0   |                            | 0      |   | • | 1808       |
| 29'h000000003  0.0     | 0.0     | ld (r2), r0 ···1812 1;0;bra 13,h1fec···1813 0;0; add r2, r3 ···1814 0 | 1812 1 0     | bra 13'h1fec | 1813              | 0.0 | add r2, r3                 | 1814   | • | • | . 1811     |
|                        | •       |   |              |              |                   |     |                            |        |   |   |            |
| 29'h02468ad0           | L2:     |   | •••          |              |                   |     |                            | 0      |   | • | 0 • • 1815 |
|                        |         |   |              |              |                   |     |                            |        |   |   |            |

FIG. 24

|                   | 1900           |                              |   | 1911  | 1771 | 0 · · 1915   | 1 |
|-------------------|----------------|------------------------------|---|---|------|--------------|---|
|                   | 1903 0         | 1906 0 0 add r0, r41907 0    | C   | 3 191410  |      | 0            |   |
|                   | dou            | add r0, r                    | 1910  | add r2. r   |      |              |   |
| E                 | 1:0            | 0.0                          | 25  | 0:0   |      |              |   |
|                   | 1902  1:0; nop | 1906                         | and r1, r3 ···1909 1 1 mov 32 h12345680, r2 | ld (r2), r0 ···1912 1:0;bra 13h1fec···1913 0:0; add r2, r3 ···1914 0 · · 1911 |      |              |   |
|                   | dou!0!0!1061   | 1:0.jsr f                    | 1 1 mov 3                                   | 1:0.bra 13  |      |              |   |
| 1001              | 1061           | mov r2, r1 ···1905 1;0;jsr f | 31909                                       | 0 …1912   |      | :            |   |
| +01               | 121            | mov r2, r                    | and r1, r2                                  | ld (r2), r  |      |              |   |
| 0.0               | 10.17.         | 0.0 L1:                      | 0.0   | 0.0   | :    | L2:          |   |
| 29'b00000000010:5 | 2000000011     | 29'h00000001 0 0 L1:         | 29'h00000002 0 0                            | 29'h00000003   0 :0   |      | 29'h02468ad0 |   |

FIG. 25

| INSTRUCTION | RESOLVING VALUE   | 3                         |
|-------------|-------------------|---------------------------|
| jsr f       | PC RELATIVE VALUE | 32'h00000000-32'h0000000a |

FIG. 26

| 29'h00000000 0i0if:   | 0 f:  | ret2101             | 2101 0:0:nop2102  | ···2102 11:0 nop | 2103 0 2100      | 2100       |
|-----------------------|-------|---------------------|---|------------------|------------------|------------|
| 29'h00000001 0 0 L1:  | 0 L1: | mov r2, r1 ···2105  | mov r2, r1 ···2105 1:0; jsr 13'h1ff4···2106 0:0; add r0, r4 ···2107 0 | 0,0 add          | r0, r4 ···2107 0 | 2104       |
| 29'h000000002   0 ; 0 | 0     | and r1, r3 ···2109  | and r1, r32109 1;1;mov 32h12345680, r2                                | r2 ···2110       | 10 0             | 2108       |
| 29'h00000003 0;0      |       | ld (r2), r0 ···2112 | 1d (r2), r0 ···2112 1:0 bra 13'h1fec···2113 0:0; add r2, r3 ···2114 0 | 0:0; add         | r2, r3 ···2114 0 | 2111       |
|                       | :     |                     |   |                  |                  |            |
| 29'h02468ad0          | L2:   | •                   |   |                  | 0                | 0 · · 2115 |

| 29'h00000000 0:0 f:  | ret2201             | 2201 0:00 nop2202  | 2202 1:0; nop | 2203 0   | · · 2200 |
|----------------------|---------------------|--|---------------|--|----------|
| 29'h00000001 0'0'L1: | 1                   | mov r2, r1 ··· 2205 1; 0; jsr 13'h1ff8··· 2206 0; 0; add r0, r4 ··· 2207 0 | 0:0; add r0,  | r4 ···2207 0   |          |
| 29'h000000002   0'0  | and r1, r3 ···2209  | and r1, r3 ···2209 1; 1; mov 32'h12345680, r2                              | ı, r2 ···2210 | 0  |          |
| 29'h00000003 0'0     | ld (r2), r0 ···2212 | ld (r2), r0 ···2212 11:0;bra 13'h1ff0···2213 0;0; add r2, r3 ···2214 0     | 30:0; add r2, | r3 ···2214   0   |          |
| •                    |                     |  | 1 1           |  |          |
| 29'h02468ad0 L2:     | •                   |  |               | 0  | 0 2215   |
|                      |                     |  |               | Company of the last of the las |          |

| 8 BITS. | EIGHTH                    |
|---------|---------------------------|
| 8 BITS  | SIXTH SEVENTH EIGHTH UNIT |
| 8 BITS  | SIXTH                     |
| 8 BITS  | FIFTH                     |
| 8 BITS  | THIRD FOURTH<br>UNIT UNIT |
| 8 BITS  | THIRD                     |
| 8 BITS  | SECOND                    |
| 8 BITS  | FIRST                     |
|         |                           |

INSTRUCTION PACKET(64-BIT)

| to C   | FIG. 28C          |              |
|--|-------------------|--------------|
| FIG. 28B   | IN-PACKET ADDRESS | UNIT         |
| 2-UNIT   | 3,2000            | FIRST UNIT   |
| NSTRUCTION   | 3'5001            | SECOND UNIT  |
|  | 3'b010            | THIRD UNIT   |
| 3-UNIT INSTRUCTION   | 3'b011            | FOURTH UNIT  |
|  | 3'b100            | FIFTH UNIT   |
| 5-UNIT INSTRUCTION   | 3'5101            | SIXTH UNIT   |
|  | 3'5110            | SEVENTH UNIT |
| 6-UNIT INSTRUCTION   | 3'b111            | EIGHTH UNIT  |
| O CIVIT THO I WOULD ON I WITH THE PARTY OF T |                   |              |

FIG. 29A

| LOWER 3 BITS OF<br>ADDRESS<br>LOWER 3 VALUE<br>BITS OF PC<br>RELATIVE VALUE | 3'b000 | 3'b010                       | 3'b100                                   |
|---|--------|------------------------------|--|
| REDATIVE VALUE  |        |                              |  |
| 3'b000  | 3'b000 | 3'b010                       | 3'b100                                   |
| 3'b010  | 3'b010 | 3'b100                       | 3'b000<br>(CARRY                         |
| 3'b100  | 3'b100 | 3'b000<br>(CARRY<br>IGNORED) | IĠNORED)<br>3'b010<br>(CARRY<br>IGNORED) |
| FIG. 29B  |        |                              |  |
| LOWER 3 BITS<br>OF ADDRESS<br>VALUE (TO BE<br>SUBTRACTED)                   |        |                              |  |
| LOWER 3 BITS OF ADDRESS VALUE (BEFORE BE SUBTRACTION)                       | 3'b000 | 3'b010                       | 3'b100                                   |
| 3'b000  | 3'b000 | 3'b100<br>(CARRY<br>IGNORED) | 3'b010<br>(CARRY                         |
| 3'b010  | 3'b010 | 3'b000                       | IGNORED)<br>3'b100<br>(CARRY<br>IGNORED) |
| 3'b100  | 3'b100 | 3'b010                       | 3'b000                                   |

FIG. 30

|                      |       |             | <u> </u> |   | ,                |     |            |        | ı        |            |
|----------------------|-------|-------------|----------|---|------------------|-----|------------|--------|----------|------------|
| 29'h000000000 0 ; f: | .0 f: | ret         | 2401     | ···2401 0 0 nop   | ···2402 1:0; nop | 1:0 |            | 2403 0 | <u>.</u> | 2400       |
| 29'h00000001 0:0 L1: | 0 L1: | mov r2, r1  | 2405     | mov r2, r1 ··· 2405 1; 0; jsr 13 h1ffc··· 2406 0; 0; add r0, r4 ··· 2407 0          | 32406            | 0.0 | add r0, r4 | 2407   | _        | • 2404     |
| 29'h000000002 0;0    | 0.    | and r1, r3  | 2409     | and r1, r3 ···2409 1;1;mov 32'h12345680, r2 ···2410                                 | 2345680,         | 72  | 2410       | 0      |          | . 2408     |
| 29'h00000003 0;0     | 0     | ld (r2), r0 | 2412     | ld (r2), r0 ···2412 1; 0; bra 13'h1ff4···2413 0; 0; add r2, r3 ···2414 0 · · · 2411 | 42413            | 00  | add r2, r3 | 2414   | •        | . 2411     |
|                      | :     |             |          |   |                  |     |            |        | _        |            |
| 29'h02468ad0         | L2:   |             | :        |   |                  |     |            | 0      | ·        | 0 · · 2415 |

FIG. 31A

| LOWER 3 BITS OF<br>ADDRESS<br>VALUE<br>BITS OF PC<br>RELATIVE VALUE | 3'b000 | 3'b010 | 3'b100 |
|---|--------|--------|--------|
| 3'b000  | 3'b000 | 3'b000 | 3'b000 |
| 3'b010  | 3'b010 | 3'b010 | 3'b010 |
| 3'b100  | 3'b100 | 3'b100 | 3'b100 |
|   |        |        |        |

FIG. 31B

| LOWER 3 BITS OF<br>ADDRESS<br>VALUE     |        |        |        |  |
|---|--------|--------|--------|--|
| LOWER 3<br>BITS OF PC<br>RELATIVE VALUE | 3'ъ000 | 0b010  | 0b100  |  |
|   |        |        |        |  |
| 3'b000                                  | 3'b000 | 3'b000 | 3'b000 |  |
| 3'b010                                  | 3'b010 | 3'b010 | 3'b010 |  |
| 3'b100                                  | 3'b100 | 3'b100 | 3'b100 |  |
| 1                                       |        |        |        |  |

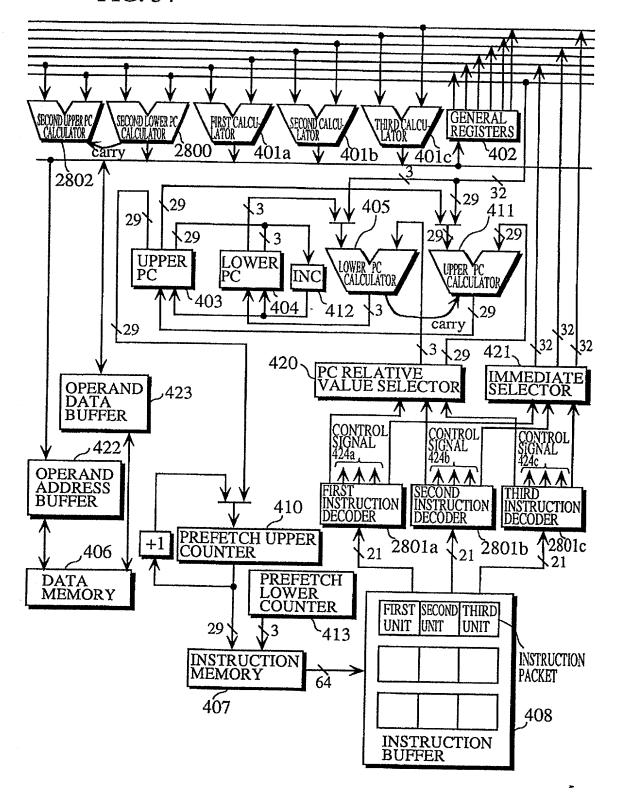
FIG. 32

| • 2600                |  |  |  | (<br>(<br>) | 0 · · 2615   |
|-----------------------|--|--|--|-------------|--------------|
| 2603 0                | mov r2, r1 ···2605 1;0;jsr 13'h1ff8···2606 0;0; add r0, r4 ···2607 0 | 0  | ld (r2), r02612 1:0;bra 13'h1ff02613 0;0; add r2, r32614 0 |             | 0            |
| dou                   | add r0,  | 2610   | add r2,  |             |              |
| 0.1                   | 00   | 2  | 0:0  |             |              |
| 2602 11:01 nop        | h1ff8…2606   | and r1, r32609 1; 1 mov 32'h12345680, r22610 | h1ff02613  |             |              |
| 2601 0 0 nop          | 5 1;0;jsr 13'  | 9 1; 1; mov 3                                | 2 1:0ibra 13   |             | ,            |
| 260                   | 2, rl ···260;  | , r3 ··· 2609                                | , r0 ···2612   |             | •            |
| ret                   | mov r  | and r1                                       | Id (r2)  |             |              |
| 0:0 E                 | 0 0 L1:  | 0 0  | 0.0  | :           | L2:          |
| 29'h000000000 0:0 :f: | 29'h00000001 0'0'L1:   | 29'h000000002 0;0                            | 29'h00000003 0 0   |             | 29'h02468ad0 |

FIG 33

|                     | 00 L1: mov r2, r1 ···2705 1:0 jsr 13 h1 ff6 ··· 2706 0:0; add r0, r4 ···2707 0 · · 2704 |                     | ld (r2), r0 ···2712 1 0 obra 13 h1fee ··· 2713 0 0 add r2, r3 ··· 2714 0 |   | L2:  0 · · · 2715 |  |
|---------------------|---|---------------------|--|---|-------------------|--|
| 0:0 f:              | 0 0 L1:   | 0:0                 | 0:0  | • |                   |  |
| 29'h00000000 0;0;f: | 29'h000000001 0'0 L1:   | 29'h000000002  0 ¦0 | 29'h00000003 0:0   |   | 29'h02468ad0      |  |

FIG. 34



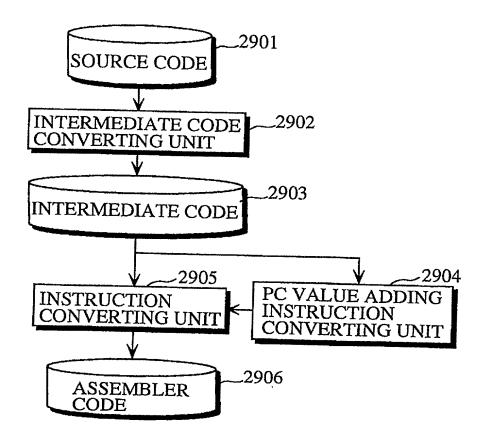
#### MNEMONIC

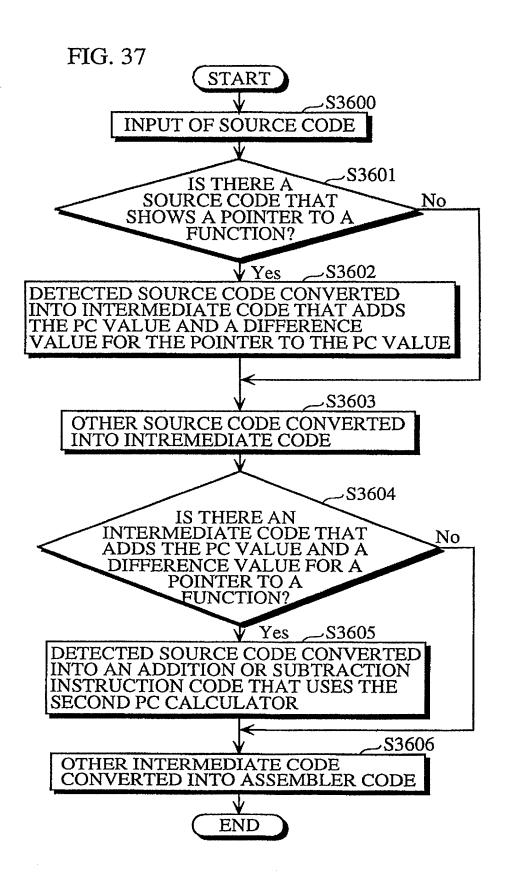
**OPERATION** 

FIG. 35A addpc disp, Rn FIG. 35B subpc disp, Rn

Rn + disp -> RnRn - disp -> Rn

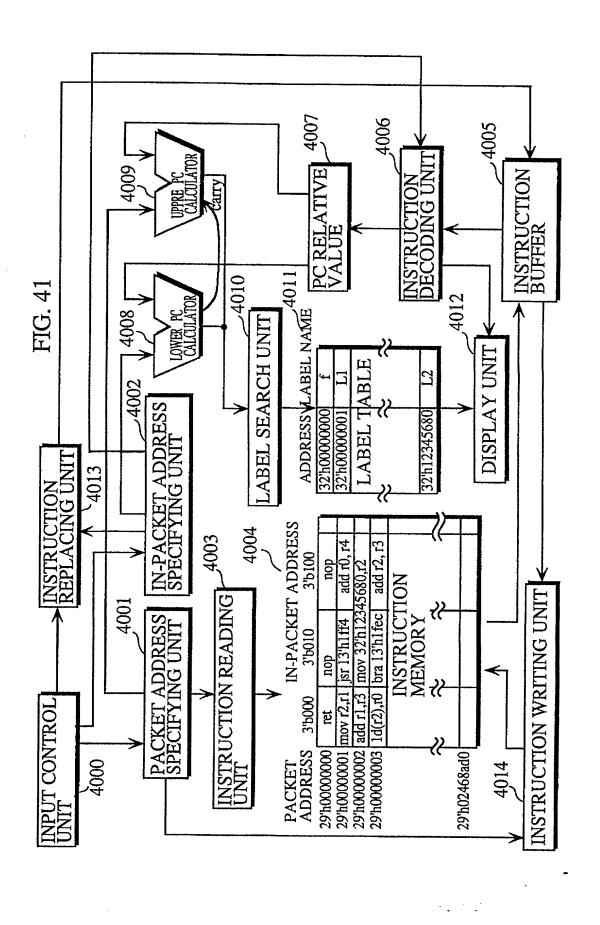
FIG. 36





| •   |                     |      |
|-----|---------------------|------|
| f:  | tmp = PC            | 3201 |
|     | i != 1              | 3202 |
|     | br L1               | 3203 |
|     | fp = (g1 - f) + tmp | 3204 |
| Y 1 | jmp L               | 3205 |
| L1: | i!=2                | 3206 |
|     | br L2               | 3207 |
|     | fp = (g2 - f) + tmp | 3208 |
| т о | jmp L               | 3209 |
| L2: | i ! = 3             | 3210 |
|     | br L3               | 3211 |
|     | fp = (g3 - f) + tmp | 3212 |
| * ^ | jmp L               | 3213 |
| L3: | fp = (g4 - f) + tmp | 3214 |
| L:  | * (fp) (i)          | 3215 |
|     |                     |      |

| f:  | mov    | PC, r1   | 3201 |
|-----|--------|----------|------|
|     | compne | 1, r0    | 3202 |
|     | br     | L1       | 3203 |
|     | addpc  | g1-f, r1 | 3204 |
|     | jmp    | L        | 3205 |
| L1: | cmpne  | 2, r0    | 3206 |
|     | br _   | L2       | 3207 |
|     | addpc  | g2-f, r1 | 3208 |
|     | jmp    | Ĺ        | 3209 |
| L2: | cmpne  | 3, r0    | 3210 |
|     | br     | L3       | 3211 |
|     | addpc  | g3-f, r1 | 3212 |
|     | jmp    | Ĺ        | 3213 |
| L3: | addpc  | g4-f, r1 | 3214 |
| L:  | jsr    | (r1)     | 3215 |
|     | ret    |          | 3216 |
|     |        |          |      |



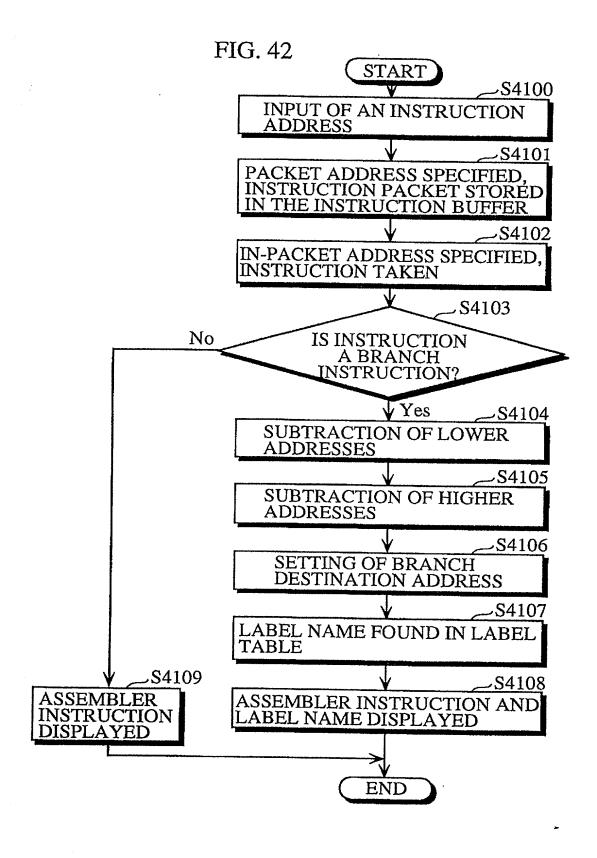


FIG. 43

